



Faculty of Engineering

ANTI - THEFT SECURITY APPLICATION USING MICROCONTROLLER

Sebastian Edwin Amin

Bachelor of Engineering with Honours
(Electronics and Computer Engineering)
2004

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2004

ANTI-THEFT SECURITY APPLICATION USING MICROCONTROLLER

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1000133646

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This project is submitted in partial fulfilment of
the requirements for the degree of Bachelor of Engineering with Honours
(Electronic & Computer Engineering)

Faculty of Engineering
UNIVERSITI MALAYSIA SARAWAK
2004

UNIVERSITI MALAYSIA SARAWAK

R13a

BORANG PENGESAHAN STATUS TESIS

Judul:

**ANTI-THEFT SECURITY APPLICATION USING
MICROCONTROLLER**

SESI PENGAJIAN: **2003/2004**

Saya

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ACKNOWLEDGEMENT

The author would like to express a big sincere thanks and gratitude to everyone involved in the quest of finishing this project.

This project has not had only academic contributions but financial as well. Special thanks to Mr. Wan Joon Wai, Samuel Abidin and Mr. Martin Anyi for both their invaluable technical advice and guidance throughout the completion of this thesis project.

The author would like to *Dedicated especially* to his parents, family and love ones for their supporting support and understanding all throughout these years.
to
my beloved family and love one

Finally, the author would like to thank his fellow mates for their small contributions in making this journey that's a success.

ACKNOWLEDGEMENT

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The author would also like to convey his outmost gratitude to his parents, family and love ones for their undying support and understanding all throughout these years.

Finally, the author would like to thank his fellow mates for their small contributions in making this project thesis a success.

ABSTRACT

Microcontrollers are widely used in many electronic gadgets nowadays. Many of which are embedded in daily domestic appliances such as in microwave ovens, refrigerator, washing machines, just to name a few.

In security and monitoring devices, microcontrollers are well embedded within the system due to its simplicity yet robust performance. This gives an added advantage to users who wish to customize its application according to operational environment needs.

In addition to its simplicity and robust performance, microcontrollers are also inexpensive, easy to modify its programming contents and certainly perfect for applications that runs on real time conditions.

Hence, this project report is intended to illustrate an overview operation of an anti-theft application device. This project will illustrate how external data is extracted and translated into electrical signals, processed accordingly and generates the intended output, while at the same time communicates with other devices via a serial link. This overview is commonly used in security application nowadays, and is a preference of choice.

ABSTRAK

Kebanyakan peralatan elektronik pada masa kini melibatkan penggunaan litar pengawal - mikro. Litar-litar ini boleh didapati dalam pelbagai peralatan domestik harian seperti dalam alat ketuher gelombang mikro, peti sejuk, mesin pembasuh pakaian, dan banyak lagi.

Penggunaan litar pengawal-mikro amat sesuai digunakan dalam aplikasi peralatan sistem kawalan dan keselamatan kerana ianya mudah disenggara dan difahami penggunaannya, selain mempunyai prestasi yang tinggi. Ini seterusnya memberi kelebihan kepada pengguna untuk membuat perubahan terhadap sistem aplikasinya mengikut keperluan operasi semasa.

Tambahan pula, penggunaan litar pengawal - mikro adalah murah dan senang didapati di pasaran, manakala kandungan aturcaranya yang mudah diubah sememangnya sesuai digunakan untuk aplikasi 'real-time'.

Oleh yang demikian, laporan projek ini adalah bertujuan untuk menunjukkan secara keseluruhannya prototaip sebuah aplikasi sistem keselamatan untuk simulasi keadaan sebenar operasi sistem keselamatan yang terdapat di pasaran. Projek ini akan menerangkan secara mendalam mengenai kaedah pengambilan data dari persekitaran, memproses data tersebut mengikut kehendak litar dan mengeluarkan output yang dikehendaki.

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NOTATIONS

A

| | |
|-----|-----------------------|
| ACC | Accumulator |
| A/D | Analog to Digital |
| ALU | Arithmetic Logic Unit |

C

| | |
|------|-----------------------------------|
| CMOS | Channel Metal Oxide Semiconductor |
| CPU | Central Processing Unit |

D

| | |
|------|-------------------------------|
| DC | Direct Current |
| DCE | Data Communications Equipment |
| DPTR | Data Pointer Register |
| DTE | Data Terminal Equipment |

E

| | |
|-----------------|--|
| \overline{EA} | External Access |
| EPROM | Electrically Programmable Read Only Memory |

G

| | |
|-----|------------------------|
| GUI | Graphic User Interface |
|-----|------------------------|

H

| | |
|------|----------------------------------|
| H | Hexadecimal |
| HMOS | Heated Metal Oxide Semiconductor |
| Hz | Hertz |

I

| | |
|------------------|------------------------------------|
| IC | Integrated Circuit |
| IDE | Integrated Development Environment |
| IE | Interrupt Enabled |
| \overline{INT} | Interrupt |
| I/O | Input/Output |
| IP | Interrupt Priority |

L

| | |
|-----|----------------------|
| LE | Latch Enabled |
| LED | Light Emitting Diode |

M

| | |
|--------|----------------------------|
| MCU | Microcontroller Unit |
| MCS51™ | Microcontrollers 51 Family |
| MS | Microsoft |

N

| | |
|-----|----------------|
| n/c | Normally Close |
| n/o | Normally Open |

O

| | |
|------------------------|--|
| $\overline{\text{OE}}$ | Output Enabled |
| OTPROM | One Time Programmable Read Only Memory |

P

| | |
|-------|--|
| PC | Program Counter |
| PC | Personal Computer |
| PCON | Power Control |
| PEROM | Programmable and Erasable Read Only Memory |
| PSW | Program Status Word |

R

| | |
|------------------------|----------------------------------|
| RAM | Random Access Memory |
| R-C | Resistance-Capacitance |
| $\overline{\text{RD}}$ | External Data Memory Read Strobe |
| ROM | Read Only Memory |
| RST | Reset |
| RS232 | Standard 9-pin PC serial port |
| RxD | Receive Serial Input Line |

S

| | |
|------|---------------------------|
| SBUF | Serial Buffer |
| SCON | Serial Condition |
| SFR | Special Function Register |
| SMOD | Serial Mode |
| SP | Stack Pointer |
| SPST | Single Pole Single Throw |

T

CHAPTER 1

| | |
|------------------|-----------------------------|
| T | Timer |
| TCON | Timer Condition |
| TL | Timer Low |
| TH | Timer High |
| TMOD | Timer Mode |
| TTL | Transistor-Transistor Logic |
| T _x D | Transmit Serial Output Line |

U

| | |
|------|---|
| UART | Universal Asynchronous Receiver Transmitter |
| USB | Universal Serial Bus |

V

| | |
|-----------------|-----------------------------|
| VB | Visual Basic |
| V _{CC} | Voltage Supply |
| V _{CE} | Voltage Collector – Emitter |

W

| | |
|-----------------|-----------------------------------|
| \overline{WD} | External Data Memory Write Strobe |
| WWW | World Wide Web |

Measurement Symbols

| | |
|----------|--------|
| A | Ampere |
| F | Farad |
| K | Kilo |
| M | Mega |
| m | mili |
| μ | micro |
| Ω | Ohm |
| p | piko |
| V | Volt |

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Microcontrollers ^[1] are widely used in industrial and consumer applications nowadays. In many cases, absolute precision, good performance, precise control and multi-tasking are issues of great concern. For example, a burglar alarm system is supposed to detect an intruder. It must be able to detect and act upon a variety of situations. With just a microcontroller connected with the proper sensors ^[2] and actuators, it can do just this and become an effective burglar alarm.

A microcontroller is an embedded computer-on-chip, whereby the processor and its support circuits are embedded together. Hence, this gives an added advantage to a smaller, inexpensive and flexible system design on which a microcontroller can be implemented with ease.

1.2 Project Objectives

The main aim of this project is the integration of different electronics components connected together via a microcontroller to construct an Anti-Theft Security Application. A software program for the alarm is also to be developed, to fully operate the system as required. Below is a summary of the project objectives.

OBJECTIVES OF PROJECT

- Identify key elements in an Anti-Theft Security Application System,
- Integrate different electronics components together,
- Construct an Anti-Theft Security Application using the integration of electronic devices,
- Developed software programs for the required alarm activation,
- Simulate the event on both hardware and software.

This report contains a detailed description of the hardware used, component specifications, schematic diagrams on various components interfaced to the MCS51TM microcontroller, and the program flow chart for the entire circuit operation.

1.3 Project Overview

The purpose of the project is to design a microcontroller based Anti-Theft Security Application. This application will solely detect computer system detachments.

The project will use sensors (magnetic switch sensors) ^[2] as input detections, while a microcontroller ^[1] will be used to evaluate the sensed data and take appropriate action.

1.4 Thesis Overview

In the early part of this thesis, the author describes the main purpose of the project, which is to construct an alarm system using a MCS51[™] microcontroller. Later in the next chapter, the author will discuss the structure and core fundamentals of a microcontroller based system particularly about the architecture, memory model, and the internal registers. Besides that, descriptions about the input sensors and actuators, peripheral latches, amplifier components as well as the RS232 serial communication will also be rendered in the literature review.

Chapter 3 will discuss the design methodology and development of the project. Details on the hardware and software design procedures and considerations will be discussed in depth in this chapter.

The results and discussions of the project will be rendered in Chapter 4. In this chapter, findings and outcome of the project are detailed in simulation test results (hardware) to provide readers technical information of the analysis done.

The conclusion and recommendation will be in the final chapter of this report. Attached at the end of this thesis report are the project's schematic circuitry, microcontroller's source codes, and the VB6.0 GUI source codes for references. The report's bibliography is also attached for future references if this project is to be improved further.

2.1 THE MCS51™ MICROCONTROLLER

A microcontroller is an integrated computer-on-chip. The Input/Output ports and memory sub-systems built in a microcontroller are specialized for control applications. The internal program memory (ROM) stores the control software and the CPU executes the instructions from the ROM. The internal data memory (RAM) allows the CPU to store intermediate data.

A very popular microcontroller widely used in control applications is the MCS51™ microcontroller manufactured by Intel Corporation^[5]. The device has the following core features:

- Single supply 5V operation using 1 μ m CMOS technology
- 4 Kbytes program memory on-chip
- 256 bytes program memory external to on-chip
- 4 output pins
- 128 Tbytes external memory
- 24 I/O pins each pin can be used as RAM addressability
- 2.5 MHz clock with 12 MHz max
- 32 bidirectional I/O lines organized as four 8-bit ports
- Multiple mode, high-speed programming Serial Port

CHAPTER 2

LITERATURE REVIEW

2.1 THE MCS51[™] MICROCONTROLLER

A microcontroller is an embedded computer-on-chip. The Input/Output ports and memory subsystems built in a microcontroller are specialized for control applications. The internal program memory (ROM) stores the control software and the CPU executes the instructions from the ROM. The internal data memory (RAM) allows the CPU to store intermediate data.

A very popular microcontroller widely used in control applications is the MCS51[™] microcontroller, manufactured by Intel[®] Corporation [5]. The device has the following core features [5]:

- Single supply 5V operation using HMOS technology
- 4096 bytes program memory on-chip
- 128 bytes program memory on-chip
- 4 register banks
- 128 User-defined software flags
- 64 Kilobytes each program and external RAM addressability
- 1 μ s instruction cycle with 12 MHz crystal
- 32 bidirectional I/O lines organized as four 8-bit ports
- Multiple mode, high-speed programmable Serial Port

- Two multiple mode, 16-bit Timers/Counters
- Two-level prioritized interrupt structure
- Direct Byte and Bit addressability
- Binary or Decimal arithmetic
- Integrated Boolean Processor for control application

Chosen for its small physical size (0.3 inch pin pitch) where design space is of

2.1.1 Microcontroller Variants

The MCS51™ microcontroller family [4] comes in with an integrated EPROM or OTPROM

The MCS51™ microcontroller family [4] comes in a variety of options:

- **Microcontroller with internal mask-programmed ROM**

Chosen for mass-produced items with a specified program embedded into the device. The advantage of this device is that it is cheap at the retail side but expensive during the initial manufacturing stage.

- **Microcontroller with internal EPROM**

Chosen for prototyping or developing microcontroller software, which is suitable for short production, runs. This device is relatively expensive because of the built-in memory and has limited programmable/erase cycles.

Table 1 MCS51™ Family Variants

| | | | | |
|-------|--------------|-------------|------------|---|
| 8051 | 4K x 8 ROM | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8052 | 8K x 8 ROM | 256 x 8 RAM | 2 x 18-Bit | 5 |
| 8051A | 4K x 8 EPROM | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8052A | 8K x 8 EPROM | 256 x 8 RAM | 2 x 18-Bit | 5 |
| 8051B | 4K x 8 ROM | 128 x 8 RAM | 3 x 18-Bit | 6 |
| 8052B | 8K x 8 ROM | 256 x 8 RAM | 3 x 18-Bit | 6 |
| 8051C | 4K x 8 EPROM | 128 x 8 RAM | 3 x 18-Bit | 6 |
| 8052C | 8K x 8 EPROM | 256 x 8 RAM | 3 x 18-Bit | 6 |

- **Microcontroller with external program memory**

Chosen for its cheap cost options and it is useful if the device is used to access other peripherals or additional memory components. However, this will reduce the I/O ports due to extra interface needed to access the program memory.

- **'Shrunk' microcontroller**

Chosen for its small physical size (0.3 inch pin pitch) where design space is of great concern. This device comes in with an integrated EPROM or OTPROM program memory but the Serial Port feature is not available.

Table 1 below shows a summary of the MCS51™ family variants.

| Device | Internal Memory | | Timers/ Event Counters | Interrupt |
|---------|-----------------|-------------|---------------------------|-----------|
| | Program | Data | | |
| 8031AH | - | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8051AH | 4K x 8 ROM | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8051AHP | 4K x 6 ROM | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8751H | 4K x 8 EPROM | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8751H-8 | 4K x 8 EPROM | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8751BH | 4K x 8 EPROM | 128 x 8 RAM | 2 x 18-Bit | 5 |
| 8032AH | - | 128 x 8 RAM | 3 x 18-Bit | 6 |
| 8052AH | 8K x 8 ROM | 128 x 8 RAM | 3 x 18-Bit | 6 |
| 8752BH | 8K x 8 EPROM | 128 x 8 RAM | 3 x 18-Bit | 6 |

Table 1 MCS51™ Family Variants